„Mitigation under the Paris Agreement“

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MIT Global Change Forum
„New Challenges in Global Change Research“
Warrenton, 31 March 2017
Emissions are rising.

Data: CDIAC/GCP

Fossil fuels and cement

Land–use change

CO₂ emissions (Gt CO₂/yr)


Global Carbon Project
We are not on track.
Does climate policy already show effects?

Data: CDIAC/GCP

CHN 10.4 ▼0.7%
Gt CO₂ in 2015

USA 5.4 ▼2.8%

EU28 3.5 ▲1.4%

IND 2.3 ▲5.2%

Data: CDIAC/GCP

Coal 15.0 ▼1.8%
Gt CO₂ in 2015

Oil 12.2 ▲1.9%

Gas 6.8 ▲1.7%

Cement 2.0 ▼1.9%
Does the renaissance of coal come to a standstill?

Risks from climate change depend on cumulative CO$_2$ emissions...
...which in turn depend on annual GHG emissions over the next decades.
The climate problem at a glance

Resources and reserves to remain underground until 2100 (median values compared to BAU, AR5 Database)

<table>
<thead>
<tr>
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<th>Until 2100</th>
<th>With CCS (%)</th>
<th>No CCS (%)</th>
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</thead>
<tbody>
<tr>
<td>Coal</td>
<td>70</td>
<td>89</td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td>35</td>
<td>63</td>
<td></td>
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<tr>
<td>Gas</td>
<td>32</td>
<td>64</td>
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Source: Bauer et al. (2014); Jakob, Hilaire (2015)
General structure of mitigation pathways

- **Peak in 2020**
- **Steep emissions reduction**
- **Carbon neutrality**
- **Net CO₂ removal**
- **Power sector decarbonization**
- **Compensate residual emissions**
- **Compensate budget overshoot**

**Re-directing investments** from fossils to low carbon and efficiency solutions

**Carbon neutral economy**
- Electrification of end uses
- Challenges:
  - Freight transport, aviation, shipping
  - Heavy industry
  - Ag emissions (CH₄, N₂O)

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LIMITS Study: Kriegler, Tavoni et al., 2013, Clim Change Econ 04:1340008
The global energy system

**Baseline**

**Climate policy**

2°C (50% probability)

- **Primary Energy**
  - Geothermal
  - Solar
  - Wind
  - Hydro
  - BECCS
  - Biomass
  - Nuclear
  - Gas w/ CCS
  - Gas w/o CCS
  - Oil w/o CCS
  - Coal w/ CCS
  - Coal w/o CCS

- **Electricity**
  - Geothermal
  - PV
  - CSP
  - Wind
  - Hydro
  - BECCS
  - Biomass
  - Nuclear
  - Gas w/ CCS
  - Gas w/o CCS
  - Oil w/o CCS
  - Coal w/ CCS
  - Coal w/o CCS
The coal pipeline in 2016

840 GW of coal fired capacity is in the pipeline across the globe. >85% is covered by 12 countries.
Even though emissions in SSA are still low, energy use is rapidly carbonizing.

If all announced and planned coal plants are realized, power-sector emissions will triple in 2013-2018, compared to 2008-2013.

Will Africa become the next China?
The 2°C budget does not leave any leeway

- Cheap and abundant coal is the driver of a „re-carbonisation“ of the energy system in some parts of the world

*All budgets are subject to considerable uncertainty, see Edenhofer et al. (2016)*
About negative and positive CO₂-pricing

Carbon pricing (with taxes or emission trading systems) is essential because of the oversupply of fossil fuels.

<table>
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<tr>
<th>CO₂ Price [$/tCO₂]</th>
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<td>0</td>
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- **Targeted**
- **Transformative**
- **Operational**
- **Introductory**

**Subsidies**

**Emerging market economy**

**Industrialised economy**

**Time**

2015

Eigene Darstellung, basierend auf @CDP
Carbon pricing revenues are sufficient to finance universal access to infrastructure.

Except for roads where Africa’s & Latin America’s cost still partially exceed revenues.

Jakob et al. (2016)
Projected cumulated infrastructure demand 2015-2030

2014 US$, trillions

Quelle: Bhattacharya, Chattopadhyay, and Nagrah (forthcoming)
Republicans for a national CO$_2$-tax

Republican elders call for new national carbon tax to replace federal regulations

GOP elder statesmen urge Donald Trump’s administration to impose a ‘free market, limited government’ response to rising global temperatures

Quelle: The Guardian, 08.02.2017